

Mediterranean, in which I have found a new form of *Lithocystis*. The formation of crystals is not the sole interesting phenomenon which characterizes the evolution of this singular gregarinid. In fact at the moment when the gregarinids, closely attached and almost motionless, begin to encyst, the amœbocytes of the liquid in the cavity of the sea-urchin attach themselves closely to their surface and form a network with dense meshes, each of them putting out a free pseudopodium on the exterior directed normally to the surface of the cyst. All the pseudopodia are rigid and of equal length: this gives to the cyst a bristly appearance, very peculiar and at first sight very difficult to explain; but the cause is no longer in doubt when by a very slight compression of the cover-glass a great number of the phagocytes leave the surface of the cyst and form in its neighbourhood an elegant network by the anastomosis of their pseudopodia.

Afterwards the amœboid cells are crammed with pigment granules, take on an elongated form, and finally enter into a state of degeneration, forming blackish masses of plasmodial appearance, which surround the greater number of the cysts. Such is the origin of the supposed plasmodia of *Lithocystis*, in which an attentive study shows the amœbocytes in all stages: young, very active, with a well-marked nucleus; others already deformed and filled with pigment, the greater portion completely granular and degenerated. The parasitic product which is known under the name of *Lithocystis* is therefore complex. The cysts are those of a monocystic, cœlomic gregarinid of normal evolution, and the crystals are an excretory product; the coloured plasmodial masses are made up of a collection of the phagocytes of the *Echinocardium*, of which the greater part are dead and charged with granular pigment. By the form of its spores, the *Lithocystis* falls naturally into the family of the Urosporidæ, alongside the genera *Urospora* and *Ceratospora*, of the general cavity of the Siphunculidæ and the Synaptidæ.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 702-705. (Studies from the Laboratory at Wimereux.)

*On a Viviparous Ephemera.* By M. CAUSARD.

Viviparity is a condition relatively rare among insects. In fact it is only observed among the Strepsiptera, and exceptionally in the three orders of Hemiptera, Diptera, and Coleoptera. Among the first, many of the Aphidæ and the Cochinellidæ are viviparous for the parthenogenetic generations. Among the Diptera, the Pupiparæ, certain Muscidæ (*Tachina*, *Sarcophaga*), and several Œstridæ parasitic on mammals; the pædogenesis of the larval forms of *Cecidomyæ* is also accompanied by viviparity. Lastly, among the Coleoptera there are only known certain Staphylinidæ which live as parasites in the ant-hills of South America (*Spirachtha*, *Corotoca*).

One would certainly not expect to encounter viviparity among the Ephemeræ, which have the reputation of living but a very short time in the adult state, a few hours at most, in certain species.

According to observers, these insects, as soon as born, copulate;

then the females lay eggs rapidly and soon die. This short existence is incompatible with the development of the embryo in the maternal organism. Nor is this rule general: I have studied recently a species of the Ephemeriðæ in which an entirely different state of things prevails; this is *Chloeopsis diptera* (Latr.). This species is very common in houses at the end of summer and the commencement of autumn, when these insects attach themselves to the windows or the ceilings, and there rest immovable, their two wings turned back and applied one against the other, the posterior part of the abdomen terminated by two long filaments, turned back upon the dorsal aspect. The same insect may be observed in the same place for several days. Having captured a large number of them, I have been able to keep them for more than three weeks before they laid their eggs. I have found it impossible to fix exactly the duration of their existence, because at the time of capture I did not know how long they had emerged from the nymph state. However that may be, there are Ephemerae which have but little title to the name. This relatively long existence in the adult state is in accord with their processes of reproduction.

Desiring one day to study the circulation of the blood in one of these insects, in the living state, which I supposed to be sufficiently transparent for the purpose, I took one of them and placed it between two plates of hollowed glass. The pressure of these plates caused a quantity of greyish matter to exude from the abdomen of the animal; I regarded the insect as dead and my observations a failure. Nevertheless, on examination with the microscope, I observed that the extruded matter was formed of a great number of little ovoid bodies, which immediately began to move about and unroll themselves. Each of them was a little larva, which was very active and began to swim about. Were these Ephemerae viviparous? This was the question that I at once asked myself. Then I examined the contents of a large number of individuals, and I found eggs in every stage of development: in some the segmentation was but slightly advanced, but a commencement of evolution was very distinct; in others, the extruded larvæ showed segmentation; the most advanced enclosed completely developed larvæ, but still enclosed the transparent membrane of the egg. I have since been able to observe the females emitting their larvæ freely without any pressure, so that their viviparity is a proven fact. When the moment approaches that the insects seek the water, they allow themselves to fall into it and float on the surface, with their wings extended, up to the moment at which the larvæ are extruded. During this operation, which lasts for a very short time, the whole of the last three segments of the abdomen are lifted upwards so as to form almost a right angle with the rest of the body. The larvæ are expelled by a double orifice pierced between the seventh and the eighth abdominal rings; these two openings are only separated from one another by a very slight portion of tissue, and generally break into one another so as to become one after the deposition of the eggs; there results a large slit, which involves the whole of the lower half of the line of junction of these two rings. In this case

the digestive tube is burst, so that the nerves are detached behind the last nervous ganglion which occupies the seventh abdominal ring. These observations led me to study the female genital apparatus, which ought to be constructed with a view to the internal development of the eggs. Almost the whole of the body of the female is occupied by two huge sacs attached, the one to the other, along the middle line; the vertical partition which separates them is traversed by numerous tracheæ. These sacs extend over the whole abdomen, with the exception of the last two segments, and reach as far as the head, occupying in the three thoracic rings almost the whole of the space left free by the muscles of the wings and legs. Beneath them is the digestive tube, reduced to a canal with a thin and delicate wall, and the nervous chain. These two sacs open on the outside, each by a distinct orifice pierced in the membrane which joins the seventh abdominal ring to the eighth, and, as already described, at the moment of the exit of the larvæ these two openings run together to form one. To what part of the genital apparatus of other insects does this double incubation sac correspond? I have not yet been able to settle this point, inasmuch as I have only had under observation insects in which the sacs were already filled with eggs in course of development, and in which the empty and shrivelled ovaries were with difficulty visible. In spite of the relatively long duration of their life, the *Chloocopes* take no more food in the adult state than the other Ephemera. Their mouth is only armed with a few soft and incomplete parts.

The larvæ are elongated, very active, armed with feet terminated by a single hook. The head, roughly pentagonal in form, bears two long antennæ and five ocular spots, of which one, odd, is situate between the bases of the antennæ; the four others are arranged in two pairs, of which the posterior furnishes the reticulated eyes of the adult. The mouth is provided with a masticatory apparatus, which is well formed. The abdomen is formed of ten segments, of which the last bears two long filaments provided with a few stiff hairs. The length of the body is 0.7 millim., not including the caudal filaments, which are at least as long as the body. The cephalothorax and the anterior part of the abdomen contain at birth brilliant globules, which disappear in a day or two. During the first period of their existence the larvæ have neither tracheæ nor tracheal branchiæ. Six days after their birth the larvæ undergo a first change: their appearance changes but little, but on each of the 2nd, 3rd, 4th, 5th, and 6th abdominal rings there appears a pair of short prominences, each as much developed as the others, the rudiments of the future tracheo-branchiæ. Three days later there is another change: the five prominences just mentioned become elongated, and a pair of them appear on the first abdominal ring; the tracheæ also become visible. After the third change, the five pairs of tracheo-branchiæ are well-formed and receive the tracheæ. Those of the first ring do not develop completely until the fourth change, and, finally, those of the seventh abdominal ring, apparent at the third change, are not complete till after the fifth. From that time the larva possesses all its organs. I hope to be able to pursue these investigations up to the adult stage.—*Comptes Rendus*, 1896, tom. cxxiii. pp. 705-708.